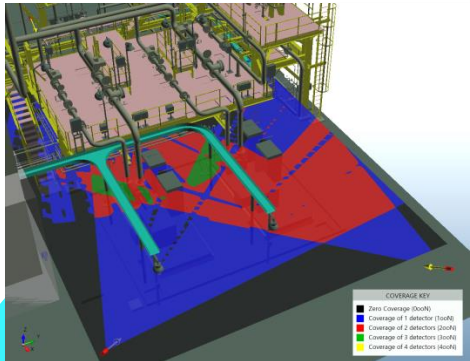


HSE

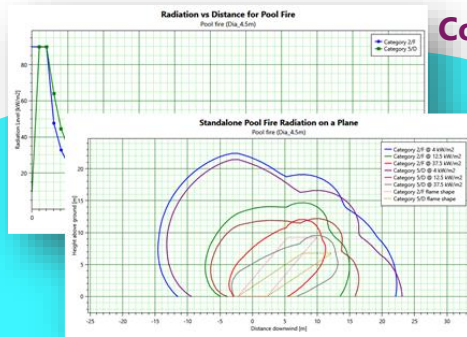
HSE services focus on systematic identification and evaluation of plant risks based on our long experience in on-site HSE and our own excellent evaluation methods, and on proposing systems that can ensure safe plant operation without major CAPEX.



Fire and Gas Mapping Study Technology



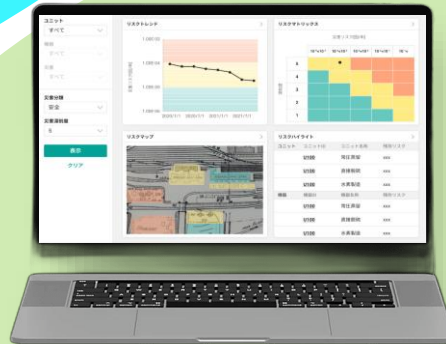
Quantitative Risk Analysis (QRA)



Fire Hazard Simulation

Consulting Service

Application Product



CoreSafety®

Service Menu

◆ Operational HSE Risk Management Program

HSE Risk Management

- HAZID/HAZOP/SIL/LOPA (*) /Bow-tie
- Consequence Analysis/CFD/QRA
- Operational Hazard Reduction

◆ Fire Protection Improvement Program

Active Fire Protection Assessment

Fireproofing Assessment

Fire and Gas Assessment

◆ HSE Improvement Program

Escape Simulation and Assessment

Hazardous Area Classification (HAC) Optimization

Noise Assessment

◆ Application for Risk-Based Process Safety

CoreSafety®

(*)HAZID : Hazard Identification Studies / HAZOP : Hazard and Operability Studies / SIL : Safety Integrity Level / LOPA : Layer of Protection Analysis



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

HSE Risk Management



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

HSE Risk Management

Do you have any of these issues?

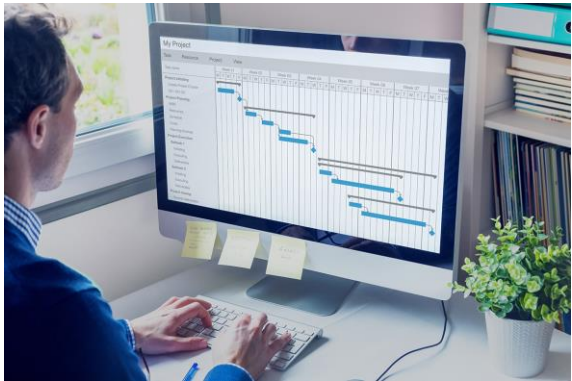
- ☹ **Formalizing facility safety**
- ☹ **Revalidation of facility safety**
- ☹ **Process and operational safety concerns**
- ☹ **High insurance fees**

HSE Risk Management Solutions

- Formal Safety Assessment
 - Quantitative Risk Analysis (QRA)
 - Hazard Identification (HAZID)
 - Hazard and Operability Studies (HAZOP)
 - Layer of Protection Analysis (LOPA)
 - Bowtie Analysis
- Consequence Analysis, CFD Modeling
- Operational Hazard Assessment/Reduction Study
- HSE Management System Review

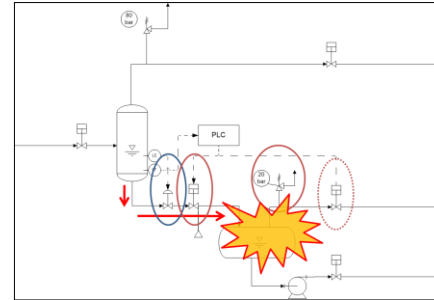
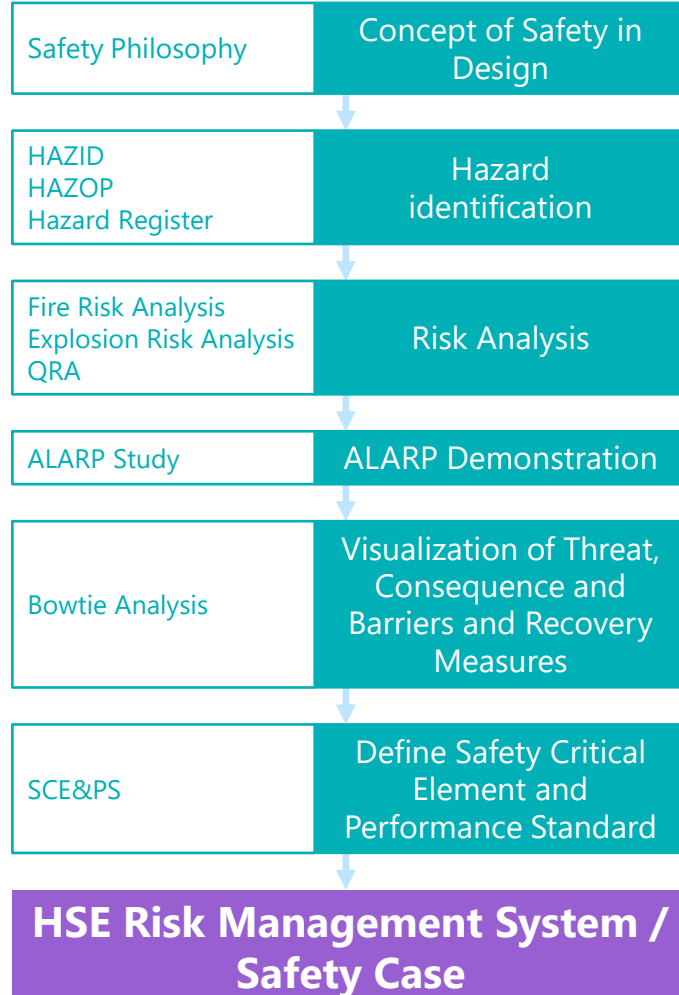
Hazard Assessment		Potential Hazards		Previous Hazards (Incidents/Near Misses)
		General	Process	
Hazard Identification		HAZID	HAZOP	OHR *
Risk Assessment	Qualitative	HAZID	HAZOP	OHR *
	Semi-Quantitative	LOPA		
	Quantitative	Consequence Analysis / QRA		

* OHR : Operational Hazard Reduction Study



Combination of Desk-top Study and Workshop

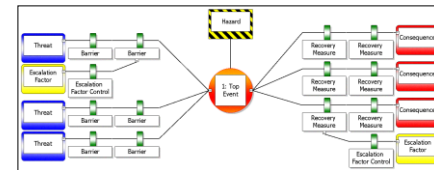
Workflow & Results



Hazard Identification in P&ID



QRA



Bowtie Diagram

Our Strengths

- Professional Safety, Process, Control, Mechanical, Operation and Maintenance Teams**
- Top global experience of EPC** execution and Consultation
Plant types - Refinery, Gas Processing, LNG, Chemical
Plant locations – Onshore, Offshore
Clients – IOC, NOC
- Huge record of HAZID/HAZOP/LOPA/QRA** and Operational Hazard Reduction
- CFD Analysis Specialist** for detail simulation

Our Experiences

20+
Cases

20+ HAZOP revalidation, OHR, and HSEMS development

500+
Cases

500+ Process safety plant design



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Active Fire Protection Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Active Fire Protection Assessment

Do you have any of these issues?

- ☹️ **Fire and explosion incidents**
- ☹️ **Modification of facility**
- ☹️ **High maintenance and inspection cost**
- ☹️ **High insurance fees**

Active Fire Protection Assessment Solution

- Re-evaluation for facilities based on credible fire scenario and codes and standards
- Fire scenario simulation based on identified fire scenario
- Fire fighting system evaluation by:
 - Hydraulic calculation
 - Fire water monitor coverage assessment
 - Foam system performance evaluation
 - Etc.



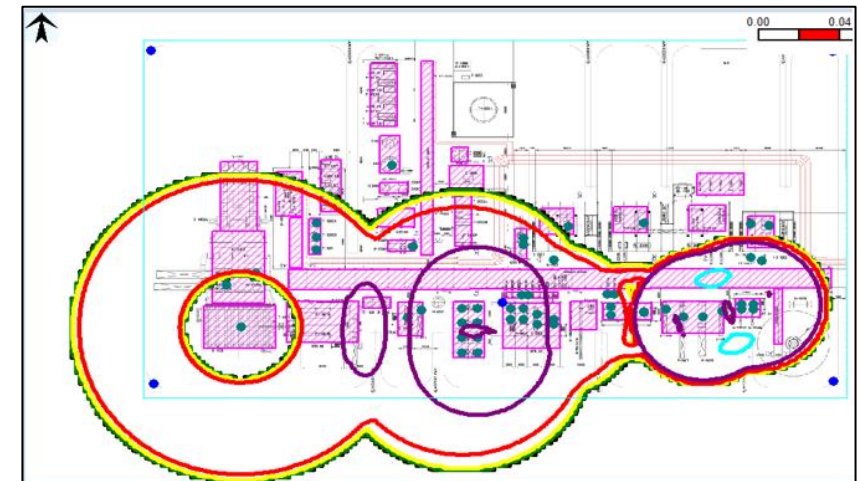
Foam Extinguisher System



Monitor Protection

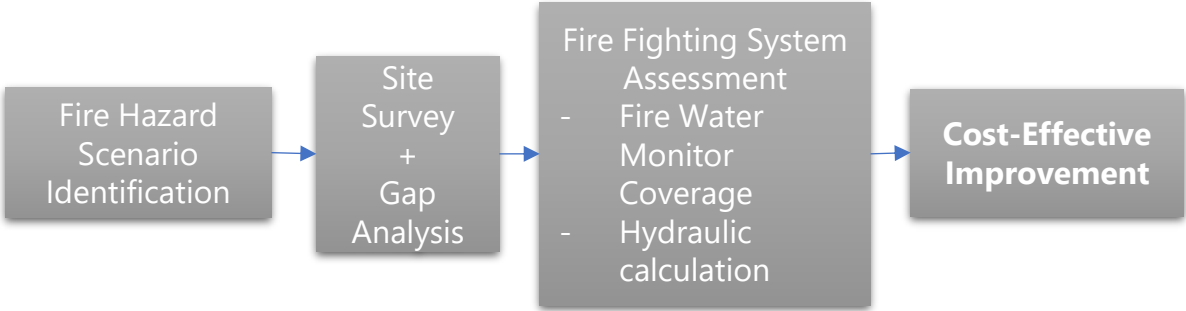


Water Spray Protection

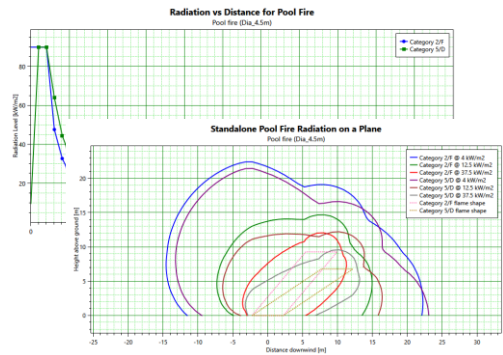


Example of Jet Fire Risk Contour

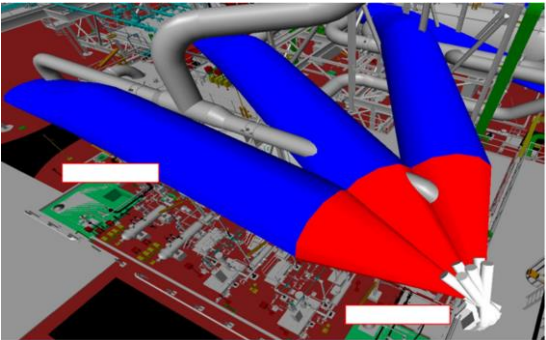
Workflow & Result



Fire Hazard Scenario + Fire Water Monitor Coverage Assessment



Fire Hazard Simulation



Visualizing Monitor Coverage in 3D model

Our Strengths

- **Professional Fire Protection and Analysis Teams**
- **Top global** experience in active fire protection design and application from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
Code and Standards – NFPA, API, BS, etc.
- **Strong relationships with global firefighting equipment suppliers**
- **Analysis software** – Phast (DNV), FLACS (Gexcon), in-house simulation,

Our Experiences

20+
Studies

Fire water monitor coverage
assessment 20+ studies.

500+
Cases

Active fire protection design
500+ cases



Operational Excellence Services

Health · Safety · Environment
(HSE)

Fireproofing Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Fireproofing Assessment

Do you have any of these issues?

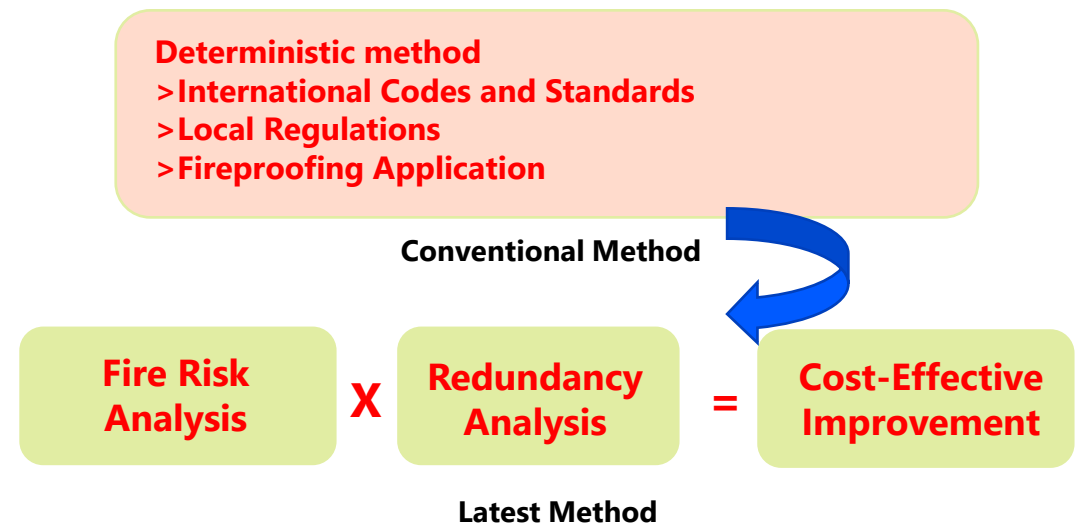
- ☹️ **Is Our Plant Really Safe from Fire Hazards?**
- ☹️ **High Maintenance Cost for Fireproofing**
- ☹️ **Compliance with Latest Standards?**

Fireproofing Assessment Solution

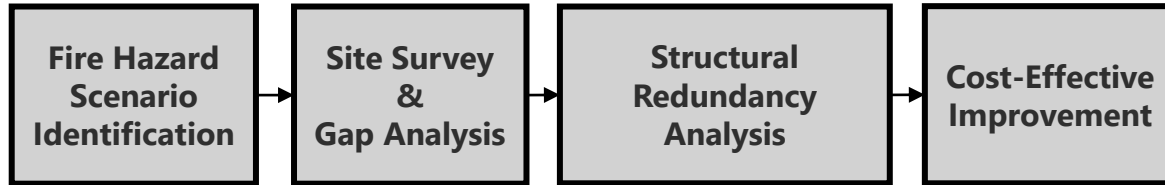
- Evaluation of existing fireproofing based on identified fire hazards and latest standards.
- Identification of critical fireproofing improvement points.
- Optimization of fireproofing by fire risk assessment and structural redundancy analysis.
- Recommendations of cost-effective improvement solutions.



Evaluation of Existing Fireproofing

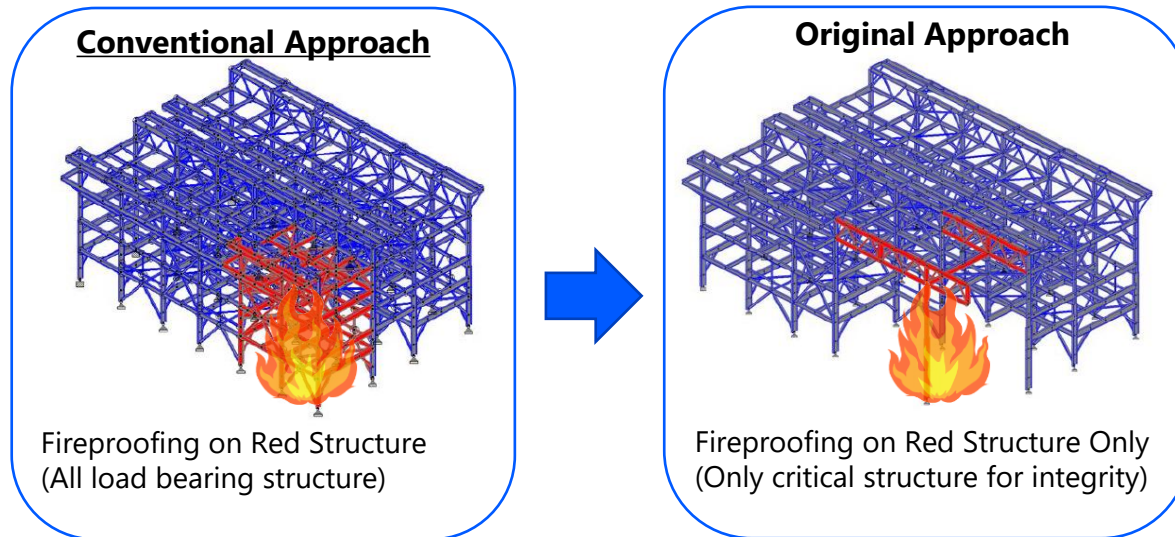


Workflow & Result



Structural Redundancy Analysis

- **JGC original method** to optimize fireproofing based on API RP 2FB



Significant Reduction of Fireproofing / Justify the Available Fireproofing

Our Strengths

- **Professional Fire Protection, Structure, Material and Analysis Teams**
- **Top global experience in fireproofing design** and application from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
Codes and Standards – NFPA, API, BS, etc.
- **Strong relationships with global fireproofing material suppliers**
- **Analysis software** – Phast, FLACS, STAAD.Pro, Abagus, etc.

Our Experiences

3+

Plants

Fireproofing assessment service for 3+ plants.

500+

Cases

Fireproofing design 500+ cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Fire and Gas Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Fire and Gas Assessment

Do you have any of these issues?

- ☹️ **Insufficient Fire and Gas detector coverage**
- ☹️ **High Maintenance Cost of fire and gas detectors**
- ☹️ **High Insurance Fees**

Fire and Gas Assessment Solution

- Evaluation of facility and gap analysis
- Identification of credible fire and gas leak hazards
- Conduct fire and gas mapping study to ensure the effectiveness
- Safety improvement by appropriate fire and gas detector placement



Gas Detector



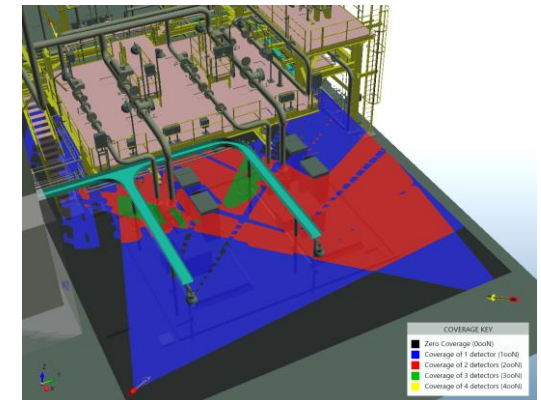
Plant are Covered by Fire and Gas Detectors



Flame Detector

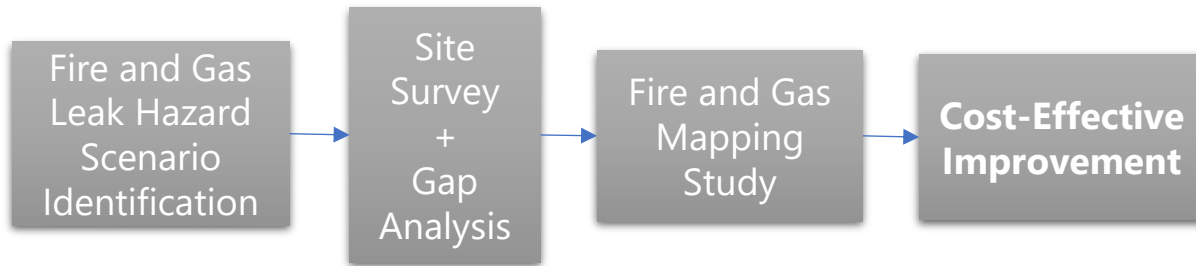


Evaluation of Facility



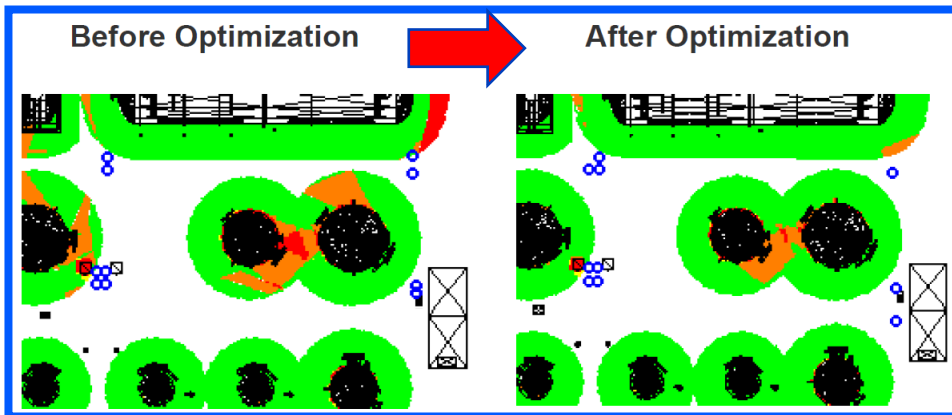
Fire and Gas Mapping Study Technology

Workflow & Result



Mapping study

One of the methods to analyze the effectiveness of fire and gas detectors, and optimize detector location



Same quantity of gas detectors --> Better coverage (wider green area)

Our Strengths

- **Professional Safety, Instrument, Process and Analysis Team**
- **Top global experience** in fire and gas system design and application from EPC execution
 - Plant type - Refinery, Gas Processing, LNG, Chemical
 - Plant location – Onshore, Offshore
 - Client – IOCs, NOCs
 - Code and Standards – NFPA, API, BS, etc.
- **Relationship with global fire and gas detector suppliers**
- **Analysis software** – Detect 3D(Insight numerics), Phast (DNV), FLACS(Gexcon)

Our Experiences

30+

Mapping Studies

Fire and Gas Mapping Study
Experience 20+ Studies

500+

Cases

Fire and Gas Design 500+ Cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

Escape Simulation and Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

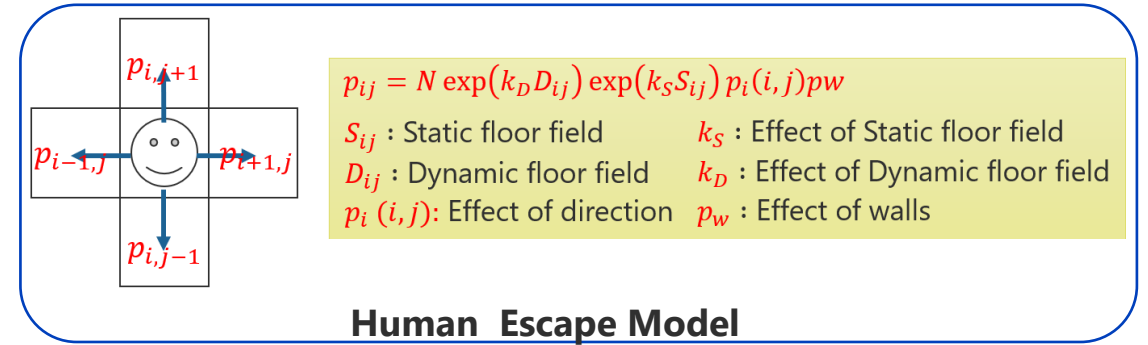
Escape Simulation and Assessment

Do you have any of these issues?

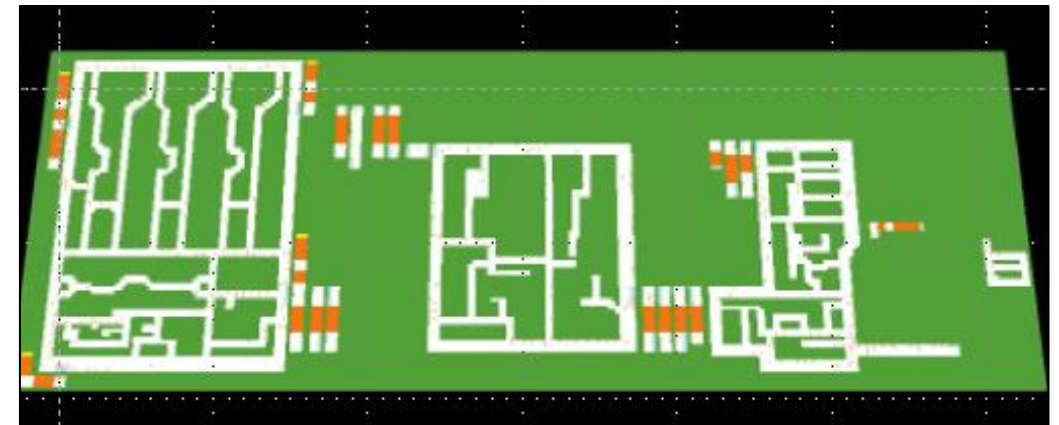
- ☹️ **Insufficient escape and evacuation plans**
- ☹️ **Maintenance plan without safety considerations**
- ☹️ **Many modifications in the facility**

Escape Simulation and Assessment Solutions

- Evaluation of current escape route by specialized escape route simulation program.
- Identification of critical points (bottlenecks) in escape route plan
- Provide improvement plan of escape route
- Escape simulation in accident scenario
- Provide safe maintenance plan (location of maintenance, number of maintenance persons, barricade plan in maintenance period)



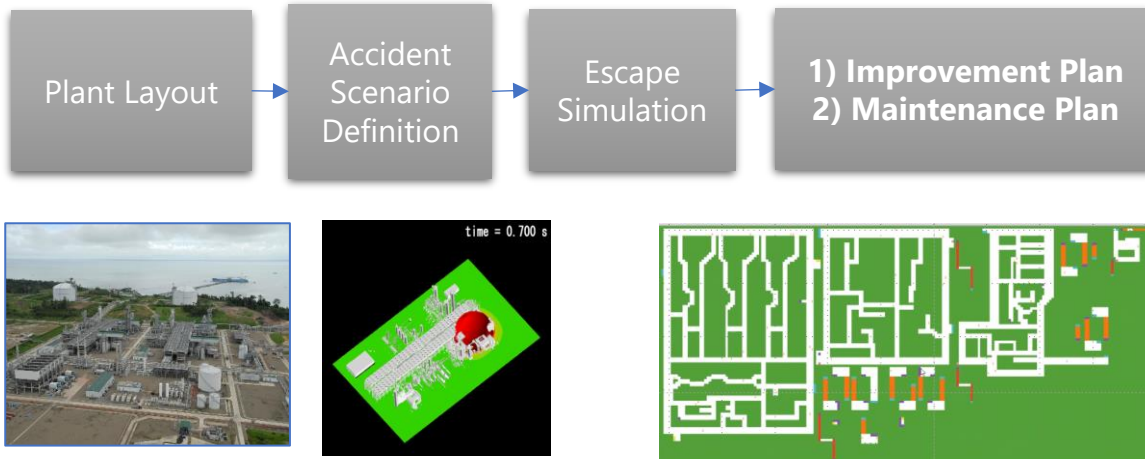
+Characteristics of Plant Facility



Specialized Plant Escape Route Simulation Program
(developed with the University of Tokyo)



Workflow & Result



OUTPUTS

1) Improvement Plan

- ✓ Modification plan of escape route to enhance safety for operators in normal situation and accidental situation

2) Visualization of Escape Behavior

3) Maintenance Plan considering safe operator escape

- ✓ Maintenance activities in same location
- ✓ Number of maintenance persons
- ✓ Barricade plan

Our Strengths

- **Professional Safety, Operation and Maintenance Teams**
- **Top global experience in escape route design** and evacuation planning from EPC execution
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Client – IOCs, NOCs
- **Specialized escape simulation program** developed with the University of Tokyo. Research article is available in "Chemical Engineering Transactions (CET) Journal Vol 90(2022)"

Our Experiences

**Plant and Escape Route
Design Cases**

500+ Cases



Operational Excellence Services

**Health · Safety · Environment
(HSE)**

**Hazardous Area Classification
(HAC) Optimization**



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Hazardous Area Classification (HAC) Optimization

Do you have any of these issues?

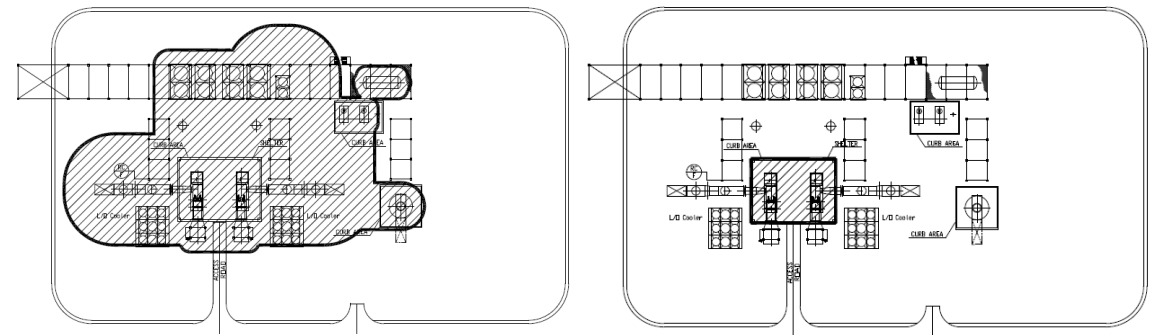
- ☹ **Cannot use unclassified electrical devices at site**
- ☹ **Many manual works for inspections and recording**
- ☹ **Increased cost for inspections and recording**

HAC Optimization Solution

- Optimize the hazardous area for unclassified electrical device with International Standards (IEC 60079-10)
- Based on the detail analysis, the classified area can be reduced or optimized
- Propose a plan to use unclassified electrical devices to minimize the accident risks



Unclassified electrical devices can not be used in hazardous areas



HAC for permanent items

HAC for portable items

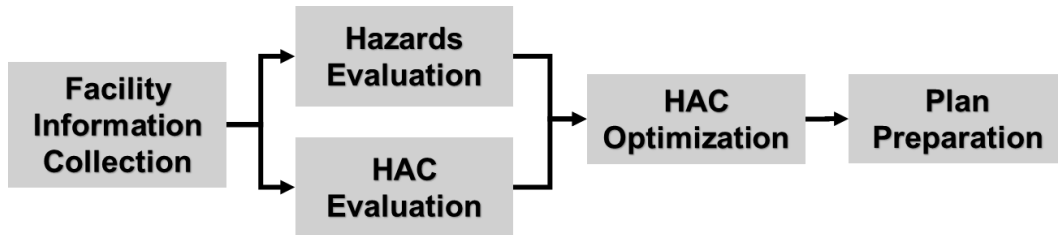
Hazardous Area Optimization for temporary use of unclassified electrical devices

Hazardous Area Classification (HAC) Optimization

[Return to
HSE menu](#)



Workflow & Result



- Collection of facilities information
- Evaluation of existing hazardous area classification
- Evaluation of potential hazards' magnitude
- Optimization hazardous area classification considering not only hazardous area classification requirements but also potential impact in case of ignition
- Preparation of plan for use of unclassified electrical devices



Our Strengths

- **Professional safety and electrical engineers** for not only hazardous area classification but also risk assessment
- **Top global experience in hazardous area classification design**
Plant type - Refinery, Gas Processing, LNG, Chemical
Plant location – Onshore, Offshore
Clients – IOCs, NOCs
- **Wide knowledge of international standards** such as, IEC, IP, EI, API, NFPA, JIS, etc.

Our Experiences

**Hazardous Area
Classification Design
Experiences**

500+ Cases



Operational Excellence Services

Health · Safety · Environment
(HSE)

Noise Assessment



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

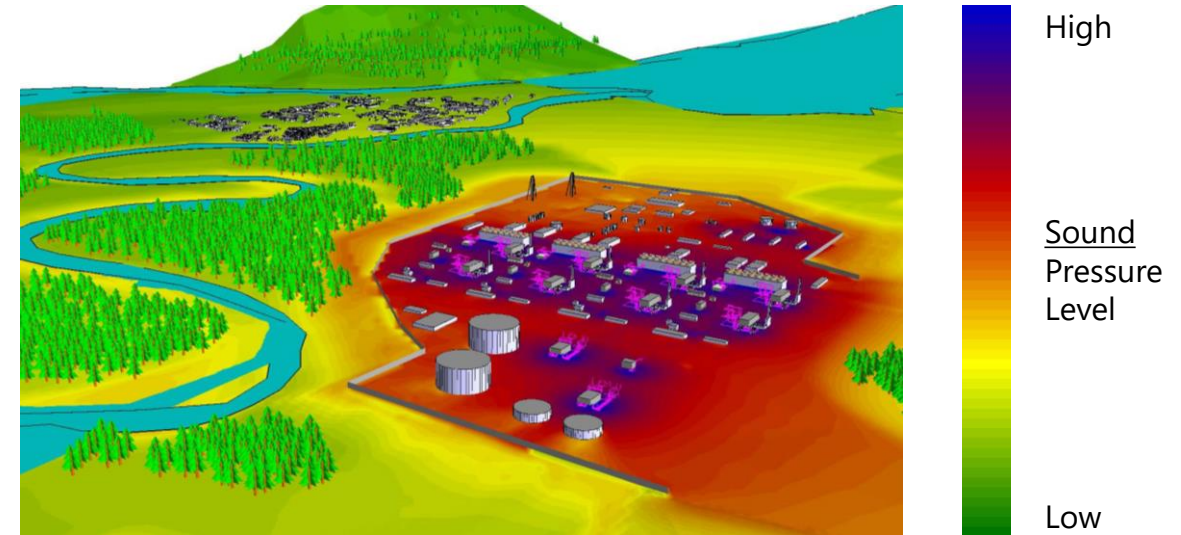
Do you have any of these issue?

- ☹️ **Noisy work environment**
- ☹️ **High cost noise mitigation for noise emitters**
- ☹️ **Need for consulting partner for noise assessment**

Noise Assessment Solution

- Through noise survey;
 - Identify noise sources
 - produce noise contour maps before and after noise mitigation plans
- Propose most effective and cost-minimum noise mitigation plans based on result of noise simulation
- Verify the effectiveness of noise mitigation plans

Noise contour map



Example of noise mitigation plan (Acoustic insulation)

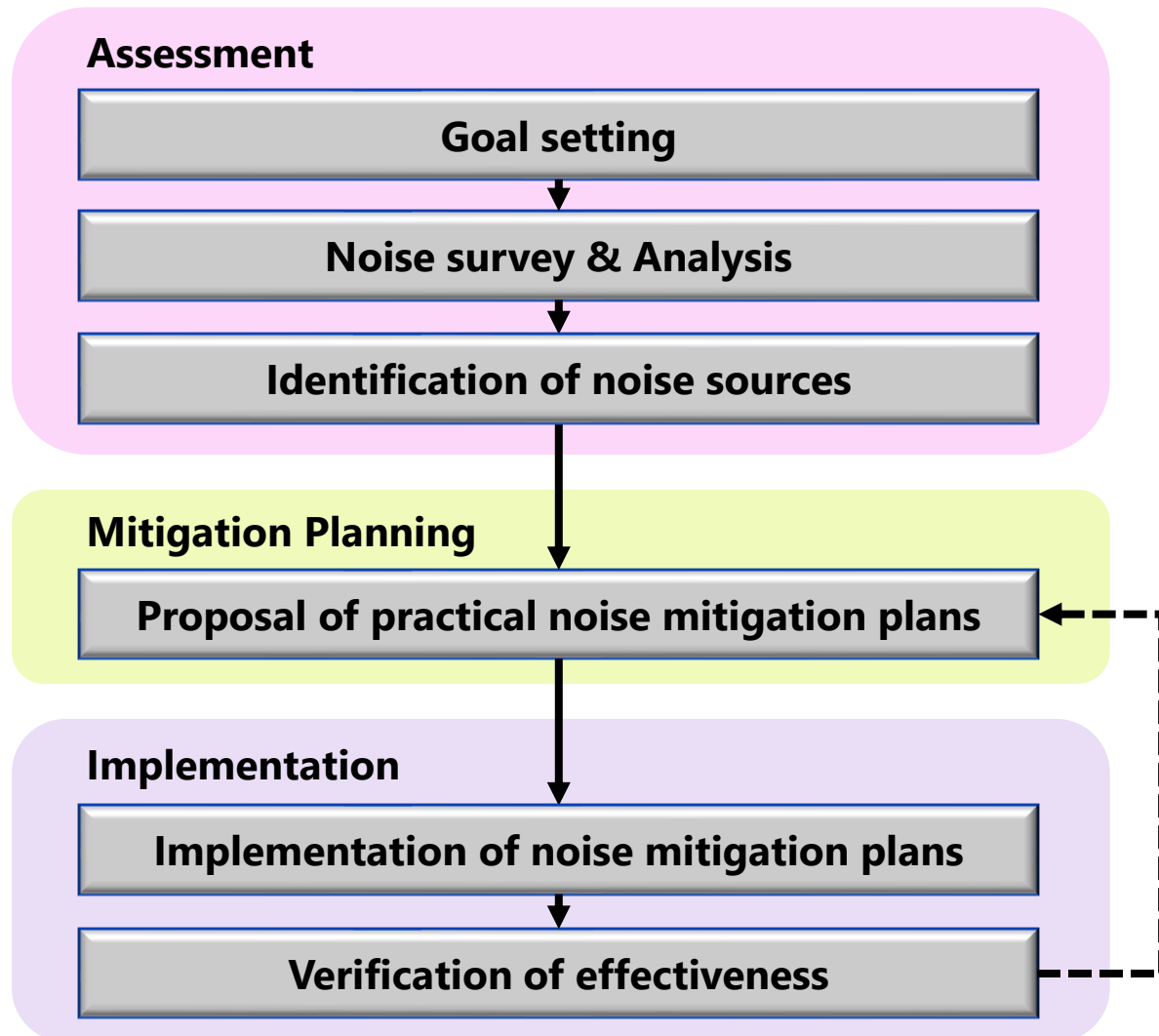


Before



After

Workflow & Result



Our Strengths

- Experienced with noise assessment/control technologies for domestic and overseas customers for many years, and solved various noise problems
- Provided services for noise survey, evaluation, planning of countermeasures, and confirmation of effectiveness after implementation of countermeasures

Our Experiences

600+
Cases

Noise assessment/control technology for 600+ cases.

50+
Years

We have been accumulating noise assessment/control technologies for more than 50 years through EPC businesses and consulting services.

Regulatory Inspections

We provide prompt and accurate measurements and analysis of site boundaries and neighborhood measurements for regulatory inspections, as well as equipment, piping, and indoor measurements within the plant site.

➤ **All Inclusive (Noise maps & Proposal)**

Measurement results are shown as noise maps, and proposal of variety of noise mitigation measures are included.

➤ Latest Measurement Technology

In addition to the conventional noise level measurement using a sound level meter, we offer the best measurement method such as measurement system using a tablet, cell phone or unmanned noise monitoring measurement with the latest technology. We will propose the most suitable measurement method for each client.

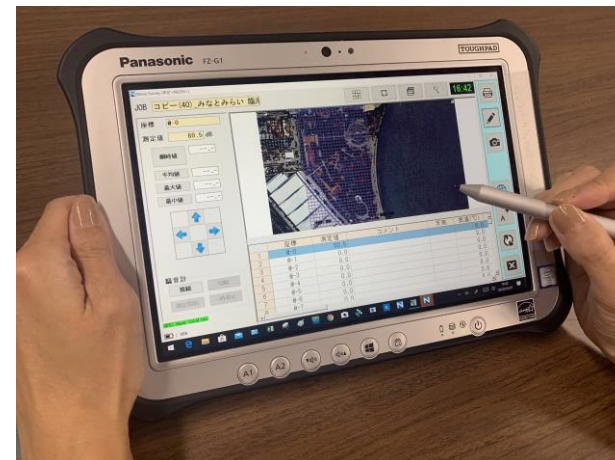
Noise Measurement and analysis



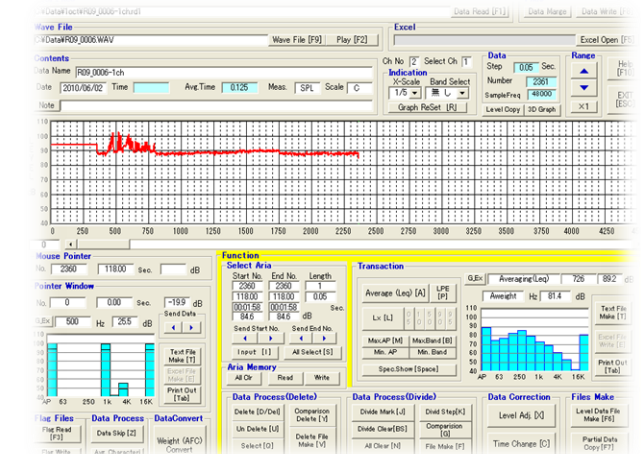
Conventional measurement



Noise monitoring



Tablet measurement system



Noise analysis



Operational Excellence Services

Health · Safety · Environment
(HSE)

CoreSafety®

Application for Risk-Based Process Safety

Powered by Brownreverse



Contact Us

 [Technology Inquiries | Contact Us | JGC HOLDINGS CORPORATION](#)

Access to Our Homepage

 <https://www.jgc.com/en/business/epc/operation-maintenance/service/>

Do you have any of these issues?

- Only limited persons know where PHA(*) data such as HAZID, HAZOP, LOPA(**) is stored
- PHA data is not actively used for optimization of asset management program
- Risk profile of facilities is not shared in organization

(*)PHA : Process Hazard Analysis

(**) HAZID : Hazard Identification Study
HAZOP : Hazard and Operability Studies
LOPA : Layer of Protection Analysis

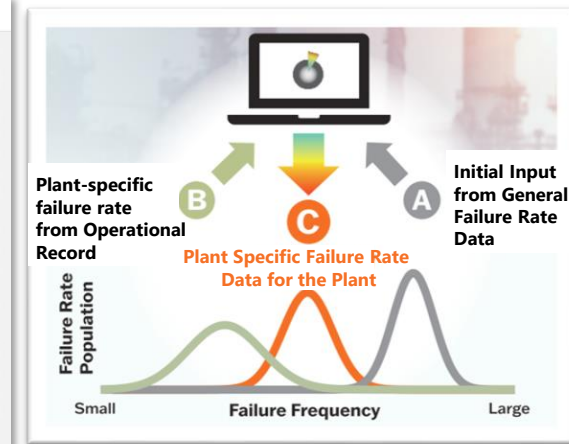
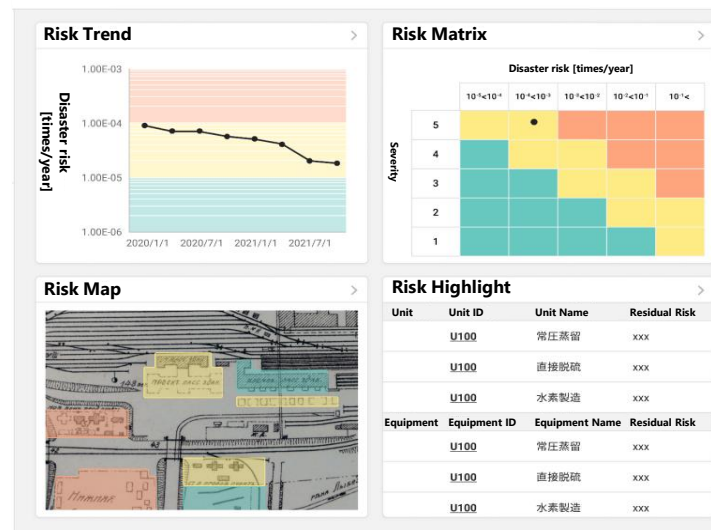
Functional Features

CoreSafety®, one of JGC in-house application, can summarize and register PHA results to visualize Risk Profile, and easily accessed through a web browser

- Risk Dashboard
- Up-to-date risk by Bayesian Update(***)
- Fault Schedule (i.e., hazard register)
- Functional Requirements' management tied with risk scenario
- Safety Performance KPI monitoring

(***) A statistical method that updates the probability for a hypothesis as more evidence or information becomes available.

Risk Dashboard



Bayesian Update

Fault Schedule

Unit	P&ID	Equipment Tag	Equipment Name	Initiating Event Group	Loss of Containment	Cumulative Initiating Event Frequency [times/year]
▶ 041	41-PID-PS-1160	041-T-1003	Depropanizer Column	気相出口閉塞	圧力超過なし (内部破壊/Process upset)	5.04 × 10 ⁻⁴
▶ 041	41-PID-PS-1160					3.29 × 10 ⁻⁴
▼ 041	41-PID-PS-1160					1.65 × 10 ⁻⁴
Initiator Tag						Initiator Frequency [times/year]
▼ 041-FV-2710		041-T-1002塔底	コンデンサ流量調整弁			1.65 × 10 ⁻⁴
Consequence Type						Residual Risk [times/year]
Safety	4					
Economic loss	3					
Environment	2					
▼ 041	41-PID-PS-1160	041-T-1003				

Outline of a risk scenario

Contributors of a risk scenario (i.e, failure rate of initiators, probability of failure on demand of safeguards)

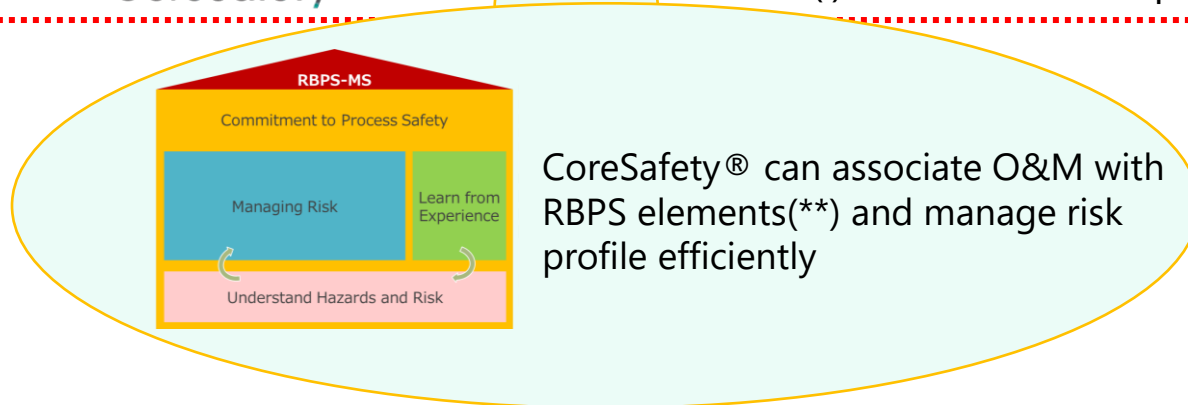
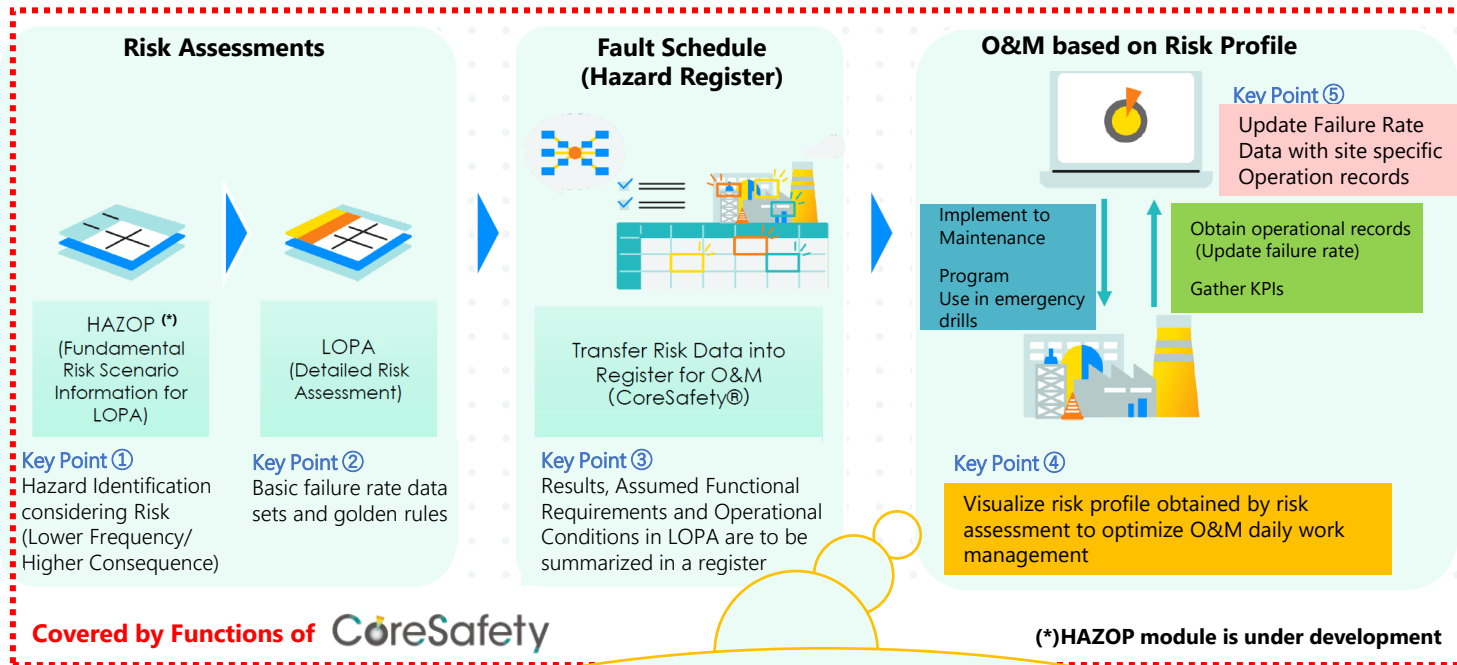
Residual risks for each consequence type (Safety, Economic loss, Environment)

Functional Requirement of the initiator and safeguards for reducing the risk (i.e., maintenance plan)

Risk Scenario

Measures

Implementation of Smart RBPS (Risk Based Process Safety)



(**)RBPS Elements are suggested by AIChE CCPS (American Institute of Chemical Engineers Center for Chemical Process Safety)

Advantages of CoreSafety®

- **Assured by Collaborative Research Projects:**
Smart RBPS methodology taken in CoreSafety is assured by a collaborative research project involving academia, regulatory bodies, and industry in Japan.
- **Risk Profile Library:**
 - 1. Based on our experience**
Be built on extensive Process Safety Management (PSM) and Process Hazard Analysis (PHA) experience in global Oil & Gas, Chemical, and Nuclear industry projects.
 - 2. Standardized Profiles**
Provides standardized risk profiles for various equipment types (e.g., pumps, fractionation columns, drums).
 - 3. Efficient Assessment**
Enables efficient risk assessments without needing detailed design information.

e.g.) Two Phase Separator
Standardized **P&ID** and **Risk Scenario** are available for risk assessments

CoreSafety® -Risk-Based Process Safety Application

Return to
HSE menu



User Benefits

BEFORE

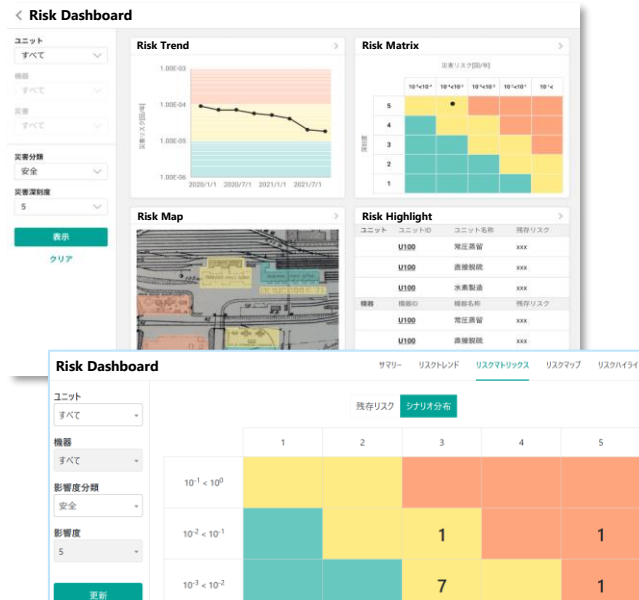
PHA by Excel/Paper

Implementation CoreSafety

AFTER

RBPS's cycle is improving

Scenario Number 2a	Equipment Number	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.
Date	Scenario Number 2a	Equipment Number
Consequence Description/Category	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.	
Risk Tolerance Crite (Category or Frequency)	Date	Scenario Number 2a
Initiating Event (Typically a Frequency)	Consequence Description/Category	Equipment Number
Enabling Event or Condition	Risk Tolerance Crite (Category or Frequency)	Scenario Title: Hazare Storage Tank Overflow. Spill not contained by the data.
Conditional Modifiers	Initiating Event (Typically a Frequency)	Frequency
Frequency of Unmit Independent Protection	Enabling Event or Condition	
Safeguards(non-IPL)	Conditional Modifiers (if applicable)	
Total PFD for all IPL	Frequency of Unmit Independent Protection	
Frequency of Mitig Risk Tolerance Crite	Frequency of Unmit Independent Protection	
Actions Required to Meet Risk Tolerance Criteria	Frequency of Mitig Risk Tolerance Crite	
Notes	Frequency of Mitig Risk Tolerance Crite	
References (links to LOPA analyst (and team members, if applicable))	Frequency of Mitig Risk Tolerance Crite	



- Visualizes Risk and Optimizes O&M Tasks
- Brings "Risk Data" to the center of RBPS Management System.

Actual Benefits of adopting CoreSafety®

Achievement of ALARP(*) Decision for Higher Risk Items

(*)ALARP : As Low As Reasonably Practicable

Improved Response and Procedure for Safety Critical Alarms by efficient training utilizing CoreSafety®

High Integrity and Reliability of Equipment and Safety Systems

Enhanced Risk Management at MOC and PTW (**)

(**)MOC : Management Of Change, PTW : Permit To Work

Sophisticated Emergency Planning for Designated Process Incidents